Uw professor achieves breakthrough in understanding superconductivity properties

November 8 2013

TeYu Chien, an assistant professor in the University of Wyoming's Department of Physics and Astronomy, is the leading author of a recently published paper that settles a longtime debate about the relationship between superconductivity and magnetism.

In an article published in the journal *Nature Communications*, Chien provides a clearer picture of the physical and chemical behavior of the interfaces between superconductor (zero electric resistance) and ferromagnetic material (materials that produce magnetic fields).

In a superconductor, electrons form pairs (Cooper pairs) with opposite spins; while in ferromagnetic materials, electrons favor parallel spins. When the spin pattern is disturbed, the superconductivity or the ferromagnetism will be disturbed or even destroyed, Chien says. When superconductors and ferromagnetic materials are brought into contact, some electrons will migrate from one to another at the interfaces and, thus, disturb the spin pattern.

"Scientists have studied this question for decades, but still debated about how far the charge will migrate across the interfaces between oxide superconductors and ferromagnetic materials," Chien says.

The main problem, he says, is that there was no appropriate tool to visualize the charge transfer at the interfaces in nanometer scale.

The scientists solved that problem using state-of-the-art, cross-sectional

scanning tunneling microscopy and spectroscopy. They revealed that the charge transfer is restricted within one nanometer from the interfaces.

"These findings are crucial for understanding the interplay between the competing phases, and also paved a way to visualize the charge-related phenomena at interfaces of many different types of phenomena—competing or collaborating," Chien says.

He says he is now applying this novel technique to the interfaces of next-generation solar cells and seeks clues to improve the solar cells' efficiency.

Chien joined the UW faculty this year. He received his Ph.D in physics (2009) at the University of Tennessee, Knoxville and was a postdoctoral researcher at Argonne National Laboratory (2009-2011) and at Northwestern University (2011-2013). His research focuses on electronic properties and many body effects of low-dimensional materials and devices, such as metal surfaces, interfaces of complex oxide systems and interfaces in next-generation solar cell devices.

"The goals are to understand the fundamental physics at these low-dimensional environments and to seek novel applications for them," Chien says.

Provided by University of Wyoming